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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Fukuda et al.	) Group Art Unit 1763
Appl. No.	:	09/511,934	)
Filed	:	February 24, 2000	)
For	:	THIN-FILM FORMING APPARATUS HAVING AN AUTOMATIC CLEANING FUNCTION FOR CLEANING THE INSIDE	)
Examiner	:	R. Kackar	)

DECLARATION UNDER RULE 1.132

Assistant Commissioner for Patents

Washington, D.C. 20231

Dear Sir:

I, Kiyoshi Satoh, a co-inventor of the above-identified application do hereby declare as follows:

1 The following experiments were conducted by me or under my direct supervision, in accordance with the example described in the present specification.

2 In first experiments, accumulation of AlF particles on a showerhead adversely caused by cleaning was examined when the temperature of a susceptor was 470 ° C, 500 ° C, or 600 ° C during cleaning (the experiments were conducted under accelerated conditions equivalent to conditions where 1,250 substrates were processed consecutively with a cleaning cycle of every 25 substrates). The results are explained below.

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3 The showerhead surface was observed upon the completion of the respective processes. When the cleaning was conducted at 600 ° C, a significant accumulation of AlF was observed. When the cleaning was conducted at 500 ° C, a slight accumulation of AlF was observed. When the cleaning was conducted at 470 ° C, no accumulation of AlF was observed.

4 After each observation, the reactor was opened and a part of the showerhead surface was wiped in a line with a unwoven fabric. The following photographs show results. As can be seen, when the cleaning was conducted at 600 ° C, a trace of wiping was clearly shown, indicating a high degree of accumulation of particles. When the cleaning was conducted at 500 ° C, a trace of wiping was slightly shown, indicating a low degree of accumulation of particles. When the cleaning was conducted at 470 ° C, no trace of wiping was shown, indicating no degree of accumulation of particles.

5 Fig. 1-1 is a photograph of the showerhead at a cleaning temperature of 600 ° C. Fig. 1-2 is a photograph of the showerhead at a cleaning temperature of 500 ° C. Fig. 1-3 is a photograph of the showerhead at a cleaning temperature of 470 ° C.

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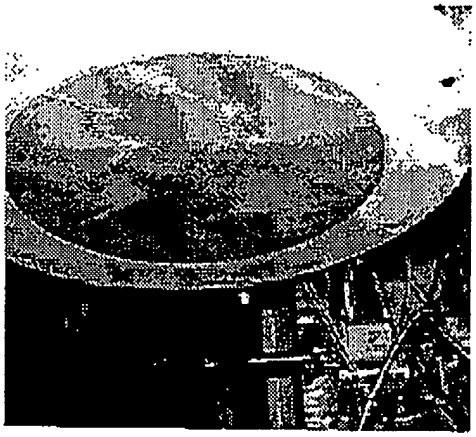

Fig.1- 1 ヒーター温度 600℃

Fig.1- 2 ヒーター温度 500℃

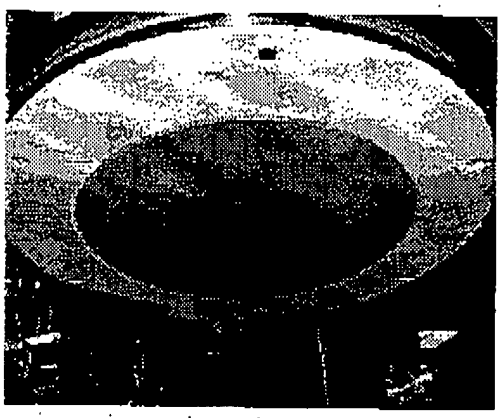

Fig.1- 3 ヒーター温度 470℃

Fig.1 各ヒーター温度でのクリーニング加速試験後のシャワープレート表面の写真

6 In second experiments, the thickness of a film formed on a substrate was measured when cleaning was conducted at 500 ° C (the susceptor's temperature) in a consecutive film formation process at 600 ° C. As shown in the graph below, a reduction of film thickness was detected after the processing of about 525 substrates.

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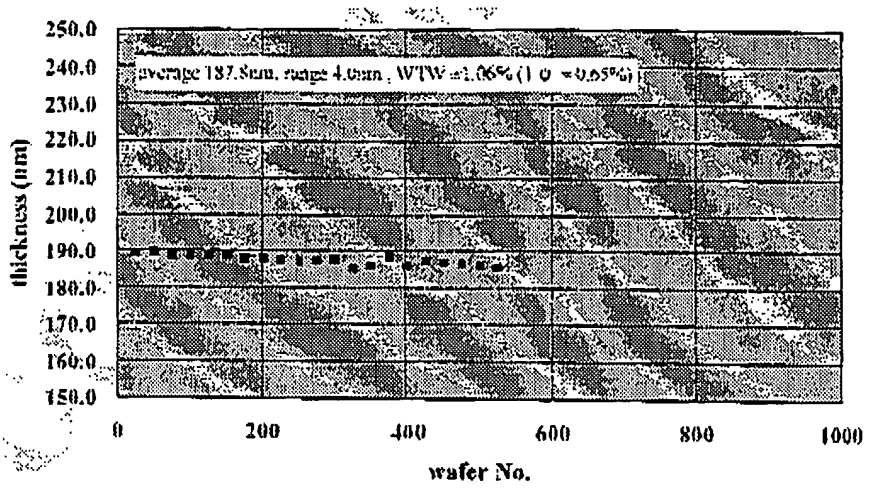

Fig.3- 2膜厚(クリーニング時ヒーター温度500℃)

7 The reduction of film thickness is attributed to a reduction of film deposition speed caused by accumulation of AlF particles on the showerhead, as explained in the present specification. In contrast, when cleaning was conducted at 470 ° C, the film thickness did not change as clearly shown in Figure 3 of the present application (wherein nitrogen gas was introduced at 2 L per minute while reducing the susceptor temperature).

8 In the above, the film stress (MPa) was also examined. When cleaning was conducted at 500 ° C, the stress of a film tended to increase as more substrates were processed (see the graph below).

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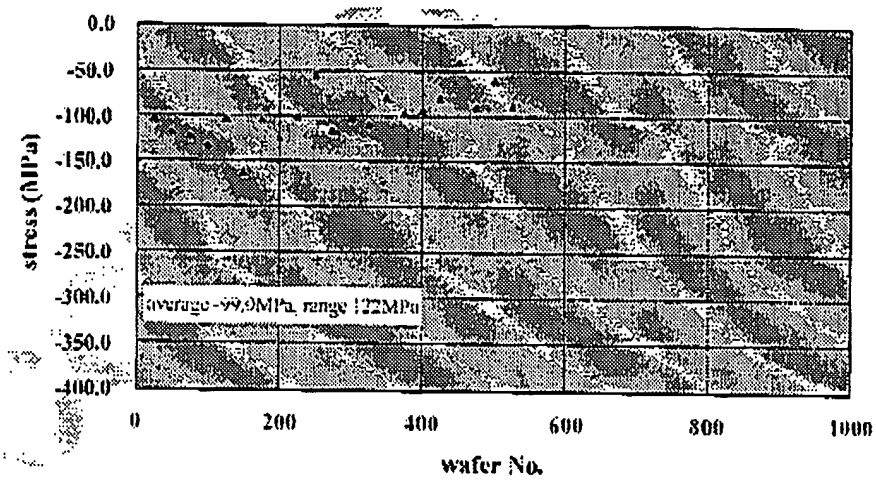

Fig.3- 4膜応力(クリーニング時ヒーター温度500℃)

9 In contrast, when cleaning was conducted at 470 • C, the stress of a film did not tend to increase as more substrates were processed (see the graph below).

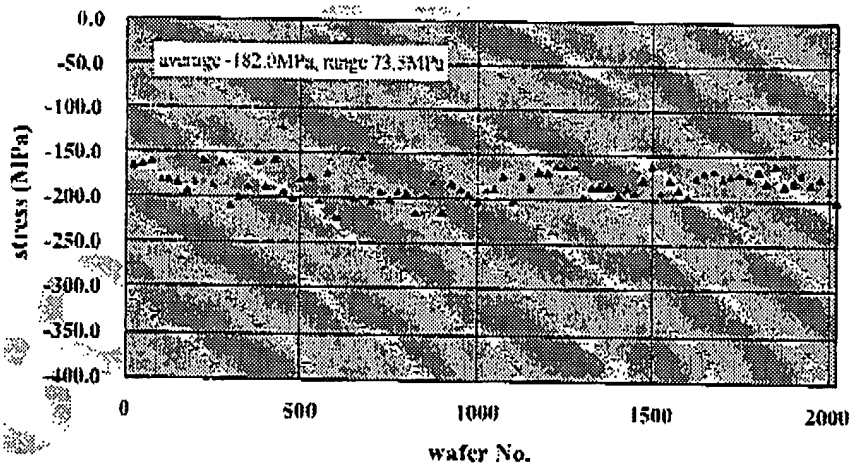

Fig.4- 4膜応力の変化

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10 I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

Dated: March 19th, 2003

By: C. Satoh

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